DACA42-02-C-0001

LOGANEnergy Corp.

Airman Dormitory Building #4650 Barksdale Air Force Base, Bossier City, Louisiana PEM Demonstration Program Midterm Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY01

Barksdale Air Force Base
Bossier City, Louisiana

May 12, 2004

Executive Summary

In October 2001, LOGANEnergy Corporation received a contract from the US Army Corps of Engineers, Construction Engineering Research Lab to test and evaluate Proton Exchange Membrane (PEM) Fuel Cells at several DOD sites. Barksdale Air Force Base, Bossier City, LA, Headquarters of the 8th Air Force was one of the sites awarded to LOGAN. This PEM demonstration site is now operational after the initial start-up occurred on December 13, 2002.
Building #4650, an airman's dormitory building was chosen for the demonstration site. It hosts a 5kW, 120vac, SU-1 PEM technology demonstration unit manufactured by Plug Power Corporation, Latham, NY. The unit operates continuously in a base load, grid parallel configuration at power setpoint of 2.5kW. The unit is instrumented with an external wattmeter and a gas flow meter. A phone line is connected to the power plant communication's modem to call-out with alarms or events requiring service and attention.
The Point of Contact for this project is Nathan Cost, Barksdale AFB Energy Manager, (318) 456-3706.
The total estimated energy cost increase to the host site as a result in participating in this demonstration project is $1677.34.

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

Airman Dormitory Building 4650 PEM Demonstration Program, Barksdale Air Force Base, Bossier City, Louisiana

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Contract: Four-year PC25 PM Services Maintenance Agreement.
In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD.

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, VA and operate in standard gird connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set a new level of performance expectations for this product, and are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partners LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a multi unit load sharing electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package installed in the project includes a 100-ton chiller that captures 210 degree F thermal energy supplied by the three fuel cells to cool the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months.

7.0 Host Facility Information

Barksdale Air Force Base, located in Bossier city, Louisiana, is headquarters for the 8th Air Force and 2d Bomb Wing. It sits on 22,000 acres of land, 20,000 of which is used for recreation and as a game reserve. In 1933, it was the largest airfield in the world, known then as Barksdale Field. Its primary aircraft today are the B-52 Stratofortress and A-10 Warthog.
American Power Company and Center Point/ Arkla Gas Company are the electricity and natural gas providers for the base respectively.

8.0 Fuel Cell Installation

The site chosen for installation is Building #4650 located in the base residential quad and serves as an Airman's dormitory. The fuel cell pad site is just outside the dorm's mechanical room providing easy access to utility power, water and natural gas service. In preparation for the installation, LOGAN processed a digging permit issued by the Civil Engineering department at Barksdale AFB. No other permits were required at this site.

The installation tasks were completed on November 20, 2002, requiring a total of 170 man-hours through completion and commissioning. The initial start attempt occurred on November 22, 2002, but was not successful because the unit's batteries depleted after multiple start cycles. Additional attempts to start the unit followed over the next two weeks with several issues hampering progress including, a week of inclement weather, troubleshooting a failed thermal couple (TC), repairing a failed weld in the reformer Proxair section, a failed battery charger, and troubleshooting a stuck valve on the humidifier. The chief reasons for the cost differential between the estimated and the actual project costs seen in Section 13 are due to the extra time repairing "out of the box" product deficiencies described above. In retrospect, these issues were more time consuming than anticipated because the PEM unit was a "reconditioned" model that had prior field service. Plug Power supplied the fuel cell for Barksdale after Avista's product, originally awarded for this site, failed to meet the FY '01 CERL BAA product specifications. Since the funding level approved for the Avista product was insufficient to purchase a new Plug unit, the only available option was to accept a reconditioned one.

The first start and acceptance certification took place on Dec 13, 2002; at which time the unit ran continuously for 8 hours. Appendix 2 documents the commissioning tasks leading to the initial start.
From that point forward, the Barksdale unit has performed below execrations and has thus far failed the Program goal of 90% operational availability. LOGAN believes that the reconditioned unit provided for this site was ill suited for the task. The site work logs attached below as Appendix 3 chronicle 9 months of maximum effort in pursuit of this goal. Close scrutiny of the logs raises the notion that the chronic electrical and mechanical deficiencies uncovered in the unit are systemic and need correction at the factory level. Without diminishing the Program's core value, it is important to recognize that something else very important has been taking place precisely because of the unit's unavailability. This project has exposed LOGAN, at once, to major field service tasks and overhauls, including rebuilding reformers, replacing cell stacks and rebuilding inverters; even to inventing new field modifications and service procedures to impress performance, while continuous troubleshooting episodes have covered every possible system deficiency. The learning curve experience that is occurring at this site normally requires years of field service exposure, and would not be a part of this discussion were this unit operating at 90%. It is clear to LOGAN that what must be judged as this project's shortcomings in the strictest sense, the same is actually edifying to the broader Program objectives.

Figures 1 and 2, below, are photos of the fuel cell after being rigged onto its pad on November 5, 2002.

Figure 1

Figure 2

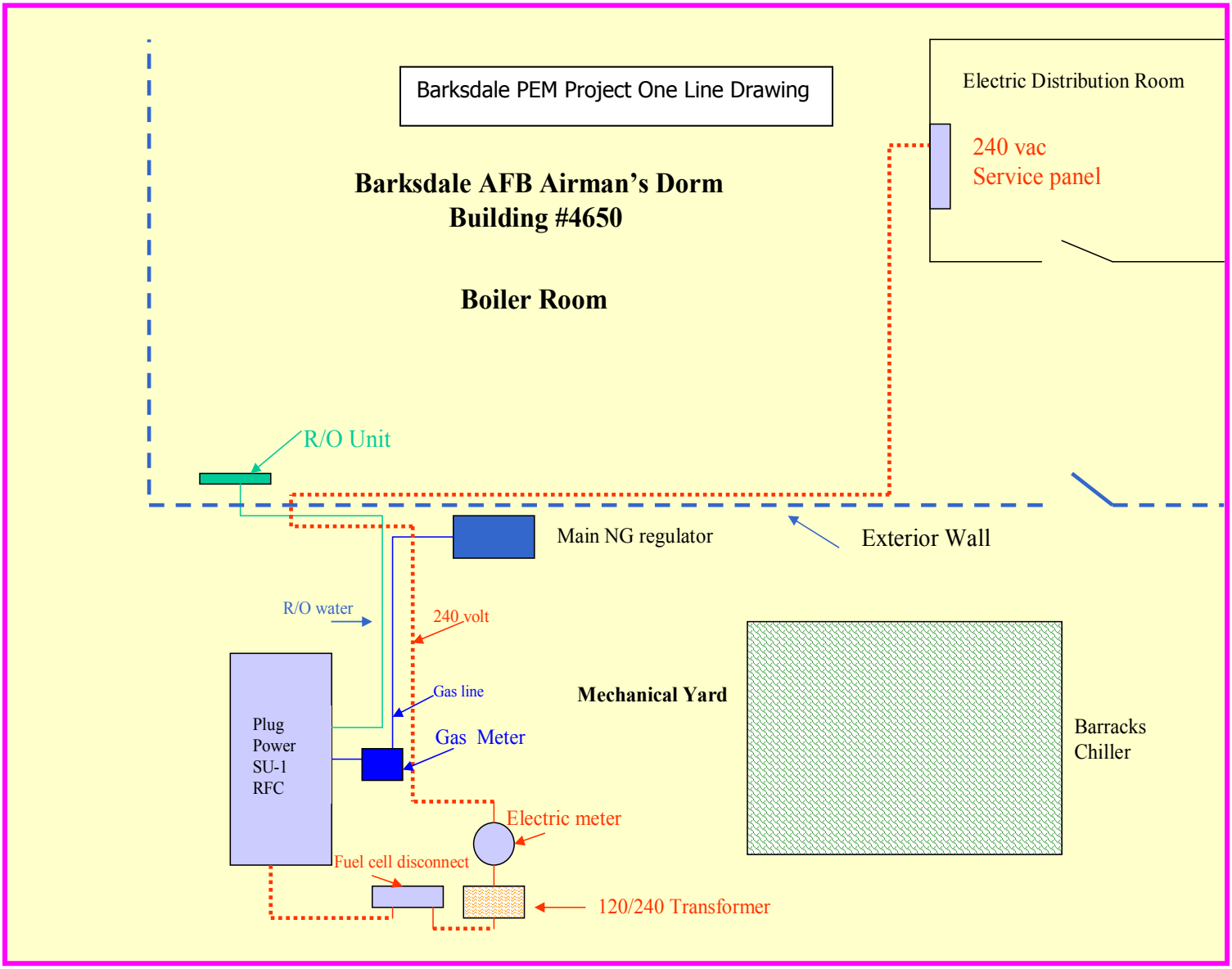

Figure 3, above, is a one line "as built" drawing of the PEM installation at Barksdale AFB.

9.0 Electrical System

The SU-1 inverter in the Barksdale fuel cell has a power output of 120 VAC at 60 Hz. However, the distribution panel in the mechanical room has connected loads at 240 VAC. In order to accommodate these loads, a 120/240 VAC step-up transformer was installed on the line between the fuel cell and the load panel. This is illustrated in the drawing pictured in Figure 8, which also traces the fuel cell conductor routing to the safety disconnect, then to the transformer, then to the meter and finally terminates at the 240vac service panel in the electric distribution room. The photos in Figures 3 and 4 below show the actual fuel cell electrical connection with the generator disconnect switch, transformer, and meter all mounted on the adjacent unistrut rack.

The unit is configured for grid parallel service only, and the electrical conduit run is approximately 40 feet from the unit to the facility load panel.

Figure 4

Figure 5

10.0 Thermal Recovery

Not Applicable at this site.

11.0 Data Acquisition System

Over the course of developing the several sites in the Fy01 PEM Program, LOGAN has encountered great difficulty in acquiring a dedicated phone line for the fuel cell at every site. In the best case this has delayed commencement of the period of performance by three weeks. At this site the base was unable to provide a discrete line to the fuel cell modem for nearly three months. In the end, LOGAN received permission to extend an existing line at the airman's dorm to the fuel cell modem to provide a data link with the factory. This is not the optimum solution, but it is an acceptable alternative for this installation since the line has very little other use at this time. These experiences have taught LOGAN to be very explicit with the host POC at the kick-off meetings about the necessity for providing a dedicated phone line since much of the success of the project is dependent upon reliable communications and data transmission with the unit.

During the period October 2002 to August 2003, LOGAN's field service technicians performed their tasks with the support of a very rudimentary SCADA system developed by Plug Power for communicating with deployed units. This system provided one-way communication from each unit to Plug's customer support center, allowing the unit to call in overnight to download a data package and an operating status report. However, LOGAN realized very quickly that the system was inadequate and unreliable to provide the high level of support needed for its wide-ranging PEM demonstration program. At times a unit called in and provided only partial data or incorrect data. This created uncertainty in troubleshooting and further delay in restoring units to service. On other occasions a unit might fail to call in for a week or more frustrating the normal chain of events leading to a service advisory. While Plug and LOGAN struggled initially with the learning curve experience in developing cooperative service norms, the weakness of the SCADA system became a major source of dissatisfaction with Plug Power. Under the circumstances the only means of determining a unit's actual status was to make a service call to the site. However, the scope of LOGAN's PEM program required a better solution. Finally, in March 2003 an event occurred that gave Plug direct insight into the shortcomings of its SCADA system. After advising of a shutdown at Ft Bragg, Plug sent its own technician to the site because LOGAN's technicians were servicing other units. The technician flew from Albany, NY to Raleigh, NC and then drove another two hours out to the site. Upon arriving, the technician discovered that the unit was operating normally. Indeed the SCADA system was not.

This event was an important turning point for the LOGAN/Plug Power relationship and it's cooperative efforts in pursuing the objectives of the PEM Demonstration Program. Six weeks later in early June, six representatives from LOGAN and eight from Plug Power met in Atlanta for two days of forthright discussions. The meeting focused on short-term methods and longer term solutions to improve remote PEM fuel cell performance. Most significantly Plug determined that it would institute immediate software changes and upgrades to insure the accuracy of fuel cell data communications. Following LOGAN's recommendations, Plug also promised to initiate a design change to its SCADA system that would permit bi-directional remote communications with the fuel cell controller. More importantly Plug promised that LOGAN's technicians would be able to remotely troubleshoot, change set points and attempt restarts under some circumstances. Lastly they also promised to publish a daily status report covering all of LOGAN's units. By early August Plug began sending daily status reports, and by mid September Plug shipped LOGAN new control software that permits remote diagnostics, monitoring, troubleshooting, and restart capabilities. Since the introduction of this new service capability along with the adoption of improved service techniques to go with it, fleet performance, availability and operating costs have begun to show positive new trends.

An external four-channel data-logger that shares the fuel cell phone line was installed to capture and store fuel cell kWh, ambient temperature, and natural gas usage. This data may be viewed at Appendix 1 below.

12.0 Fuel Supply System

Gas supply flows from a utility meter on the exterior wall of Building #4650, seen in the photo at Figure 4. A gas regulator maintains the fuel cell inlet pressure at 10-14 inches water column IWC.

13.0 Installation Costs

Barksdale Air Force Base PEM Demonstration

Project Utility Rates		
1) Water (per 1,000 gallons)	$	1.50
2) Utility (per KWH)	$	0.017
3) Natural Gas (per MCF)	$	7.70

First Cost	**Estimated**	**Actual**
Plug Power 5 kW GenSys5C	$ 42,500.00	$ 42,500.00
Shipping	$ 1,000.00	$ 1,800.00
Installation electrical	$ 2,200.00	$ 2,400.00
Installation mechanical & thermal	$ 2,400.00	$ 2,038.00
Watt Meter, Instrumentation, Web Package	$ 800.00	$ 680.00
Site Prep, labor materials	$ 925.00	$ 925.00
Technical Supervision/Start-up	$ 6,500.00	$ 15,300.00
Training	$ 5,000.00	$ 5,846.00
Total	**$ 61,325.00**	**$ 71,489.00**
Assume Five Year Simple Payback	$ 12,265.00	$ 14,297.80

Forcast Operating Expenses	Volume	$/Hr	$/Yr	
Natural Gas Mcf/ hr @ 2.5kW	0.03	$ 0.25	$ 1,993.49	
Water Gallons per Year	14,016		$ 18.92	
Total Annual Operating Cost				$ 2,012.41

Economic Summary			
Forcast Annual kWH		19710	
Annual Cost of Operating Power Plant	$	0.102	kWH
Credit Annual Thermal Recovery	$	-	kWH
Project Net Operating Cost	$	0.102	kWH
Displaced Utility cost	$	0.017	kWH
Energy Savings (Increase) (kWh)		($0.085)	kWH
Annual Energy Savings (Increase)		($1,677.34)	

Explanation of Calculations:

Actual First Cost Total is a *sum* of all the listed first cost components.
Assumed Five Year Simple Payback is the Estimated First Cost Total *divided by* 5 years.
Forecast Operating Expenses:

Natural gas usage in a fuel cell system set at 2.5 kW will consume 0.033 Mcf per hour. The cost per hour is 0.033 Mcf per hour *x* the cost of natural gas at Barksdale, $7.70/MCF. The forecast cost per year at $1993.49 is the gas cost per hour, $0.25 *x* 8760 hours per year *x* 0.9. The 0.9 represents 90% availability.

Natural gas fuel cell systems set at 2.5 kW will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed at 14,016 gallons per year is 1.6 gph *x* 8760 hours per year times 90% availability. The annual cost of water, $18.92 is 14,016 *x* cost of water to Barksdale at $1.50 per 1000 gallons times .9 availability.

The Total Annual Operating Cost, $2012.41 is the *sum of* the annual cost of natural gas plus the annual cost of water.

Economic Summary:

The Forecast Annual kWh at 19,710 kWh is the product of 2.5 kWh output of the fuel cell *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

The Annual Cost of Operating the Power Plant at $0.102 per kWH is the Total Operating Cost at $2012.41 *divided by* the forecast annual kWh, 19,710 kWh.

Credit for Annual Thermal Recovery is not applicable for this demonstration.

The Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery.

The Displaced Utility Cost is the kWh cost of electricity to Barksdale.

Energy Savings (increase) equals the Displaced Utility Cost *minus* the Project Net Operating Cost.
Annual Energy Savings (increase) equals the Energy Savings *x* the Forecast Annual kWh.

14.0 Installation Acceptance Test Report

An 8-hour acceptance test was performed on December 13, 2002 by the technician. It occurred with the first successful start-up of the system. The hours allotted for each task in the report are standard and routine. Please see Appendix 2 for documentation of the test performed by the technician.

Appendix

1) Monthly Performance Data
2) Acceptance Test
3) Work Logs

Appendix 1: Monthly Performance Data

Monthly Performance Data
Barksdale Air Force Base

	1000	Nov-02	Dec-04	Jan-04	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03
Cum Run Time (Hours)	0	667.59	1179.97	1557.97	2084.97	2433	2516.97	2679.15	2882.15	3020.41	3037.39
Cum Time in Period (Hours)	0	744	1464	2208	2928	3672	4416	5136	5339	6059	6803
Availability (%)	0.0%	89.7%	80.6%	70.6%	71.2%	66.3%	57.0%	52.2%	54.0%	49.8%	44.6%
Energy Produced (kWe-hrs AC)	0	1679	2955	3900	5217	6087	6286	6677	7170	7469	7518
Output Setting (kW)	0	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Average Output (kW)	0	2.51	2.50	2.50	2.50	2.50	2.50	2.49	2.49	2.47	2.47
Capacity Factor (%)	0.0%	45.1%	40.4%	35.3%	35.6%	33.2%	28.5%	26.0%	26.9%	24.7%	22.1%
Fuel Usage, HHV (BTUs) (1000s)	-	23,072	41,629	55,992	77,359	92,122	96,181	103,701	110,645	115,147	115,972
Fuel Usage (SCF)	-	22809	41154	55354	76477	91072	95085	102519	109384	113834	114650
Electrical Efficiency (%)	0.0%	24.8%	24.2%	23.8%	23.0%	22.6%	22.3%	22.0%	22.1%	22.1%	22.1%
Thermal Heat Recovery (BTUs)	0	0	0	0	0	0	0	0	0	0	0
Heat Rec Rate (BTUs/hour)	0	0	0	0	0	0	0	0	0	0	0
Thermal Efficiency (%)	0	0	0	0	0	0	0	0	0	0	0
Overall Efficiency (%)	0.0%	24.8%	24.2%	23.8%	23.0%	22.6%	22.3%	22.0%	22.1%	22.1%	22.1%
Number of Scheduled Outages	0	0	0	0	0	0	0	0	0	0	0
Scheduled Outage Hours	0	0	0	0	0	0	0	0	0	0	0
Number of Unsched Outages	0	1	3	4	5	7	7	8	8	10	12
Cum Unsched Outage Hours	0	76	284	650	783	1179	1839	2421	2421	3003	3730

2) Installation Acceptance Test

Installation Acceptance Test Report			
Site: Barksdale AFB...SU01R002			
Installation Check List			
TASK	**Initials**	**DATE**	**TIME (hrs)**
Batteries Installed	KW	11/20/02	2
Stack Installed	KW	11/21/02	3
Stack Coolant Installed	KW	11/21/02	1
Air Purged from Stack Coolant	KW	11/21/02	2
Radiator Coolant Installed	KW	11/21/02	3
Air Purged from Radiator Coolant	KW	11/21/02	1
J3 Cable Installed	KW	11/20/02	1
J3 Cable Wiring Tested	KW	11/20/02	0.5
Inverter Power Cable Installed	KW	11/20/02	0.5
Inverter Power Polarity Correct	KW	11/20/02	0.5
RS 232 /Modem Cable Installed	KW	11/19/02	0.5
DI Solenoid Cable Installed with Diode	KW	11/19/02	0.2
Natural Gas Pipe Installed	KW	11/20/02	8
DI Water / Heat Trace Installed	KW	11/20/02	4
Drain Tubing Installed	KW	11/20/02	1
Commissioning Check List and Acceptance Test			
TASK	**Initials**	**DATE**	**TIME (hrs)**
Controls Powered Up and Communication OK	KW	11/22/02	4
SARC Name Correct	KW	11/22/02	1
Start-Up Initiated	KW	11/22/02	6
Coolant Leak Checked	KW	11/22/02	1
Flammable Gas Leak Checked	KW	11/22/02	1
Data Logging to Central Computer	KW	2/27/03	2
System Run for 8 Hours with No Failures	KW	12/13/03	8

Appendix 3: Daily work log for Keith Williams
LOGANEnergy Field Technician
November 2002 through August 2003

Date	Activity	Hours
11/4/2002	Drove to Barksdale	6
11/5/2002	Picked up supplies to set p/p on site Fabricated foundation and worked with base personnel to place p/p on site Met with contractors to get estimates for installation	11
11/6/2002	Met with more contractors then drove home	9
11/14/2002	Drove to Barksdale and met with selected contractors to make final arrangements to get started.	8
11/15/2002	Spent morning securing digging permit for installation drove home	9
11/18/2002	Drove to local GE office to order transformer and have it shipped to Shreveport	2
11/19/2002	Drove to Shreveport to supervise contractors and to connect water line to fuel cell	8
11/20/2002	Water line to R/O panel completed and gas line with meter Completed conduit runs inside building completed Connected batteries in p/p	10
11/21/2002	Finished electrical installation and water line bundle to p/p Installed cell stack	10
11/22/2002	Insulated piping and filled p/p with fluids and performed Commissioning checks attempted start but DC volts too low to complete start Need to purchase 48 volt battery charger Drove home	14

11/25/2002 Ordered battery charger

Date	Activity	Hours
12/3/02	Drove to Barksdale got there early but weather was too bad to work	6
12/4/02	Weather again was rough so I bought a pop-up shelter hooked up charger and went for start. PP humidifier was not filling traced it down to a sticking valve. I disassembled the valve and cleaned it then reassembled it and operated it a number of times. It works fine now. Proceeded with start up was plagued with a number of different estops which led me to a gas leak in a weld. I applied some silicone and re-started. Stopped for the day after LTS heat up timed out	9
12/5/02	Started day with another time out on LTS heat up. Finished not long after when the brand new battery charger stopped working packed up and drove home	11
12/11/02	Drove back up and had enough time to attempt a start timed out again in LTS heat up. Starting to worry about the catalyst condition.	10
12/12/02	Started the day with the same nagging hardware E-stops from last trip. T/sing showed nothing wrong and p/p was ready for start so I tried again. This time I noticed that the prox out TC was not changing temp. I attempted to try the plug to be sure it was secure and had a hardware e-stop thinking the problem was the plug being loose. I re-started but had same issue with the prox time out. This time I felt for the whole TC and it came apart in my hands. Rob was going to ship me a new one for tomorrow	8
12/13/02	Installed the new TC and went for start but it timed out again on LTS heat up. Prox out was reading correct. Re-started and p/p started up with out any problems although it wasn't exporting power. Found a breaker tripped in the disconnect box. I reset it and everything was fine packed up and drove home	13
12/22/03	Drove up to check on p/p since I still have no phone. P/p had shutdown that morning on low DI water. Hour was late so t/sing would have to wait till morning.	8
12/23/02	I believe DI problem is a result of R/O in need of fine tuning Rotometer is supposed to be on it way to me but I don't have it this trip. I used measured buckets and re adjusted R/O and was going to go for start but violent weather intervened.	11

1/6/03	drove to Barksdale hooked up battery charger and reset R/O p/p started but disconnect panel breaker was cycling p/p shutdown on low cathode inlet low tried two more starts with the same results	13
1/7/03	Turns out that correcting a wiring error requires a re-phasing. That done p/p started fine and I cycled power through its power settings left it at 2.5kw for the night	9
1/8/03	Returned to site and downloaded data to send to plug drove home	10
1/23/03	Nathan called and said p/p had shut down arrived at the site in late afternoon and started t/sing it appeared there was an unbalance from the grid will try to reboot inverter and start in the morning	8
1/24/03	re-booted inverter and tried to fill DI tank but lines were frozen used 500watt halogen lights to thaw after thawing tried to start but had hardware e-stop on high stack coolant temp t/sing showed RDT was bad Plug to send new RDT will install on Monday	11
1/27/03	drove to Barksdale and installed new RDT and started p/p set power to 5kw talked to Nathan and he said we should have phone line by end of week drove home	14
2/4/03	obtained parts from Grainger and Home depot to fabricate and install new water filter system	3
2/5/03	drove to Barksdale and installed new filter system	9
2/6/03	installed phone box so Com guys couldplug right in started p/p with cable from truck due to rain	8
2/7/03	drove home	6
2/20/03	drove to Barksdale and connected phone line still no connection tried to start p/p but methane sensor kept e-stopping time to replace Prox	10
2/21/03	drove home	6
2/24/03	Drove to Barksdale changed out SARC, catalyst and Prox canister and flashed new 1.22 software	11
2/25/03	Started reduction but had to suspend after 3 hours after finding leak in the Humidifier tubing	8
2/26/03	Fixed leak and re-started reduction but kept getting HUM TOP HIGH shutdown turned out to be bad	7

	humidifier pump	
2/27/03	Installed new humidifier pump and finished reduction started p/p and verified communications and drove home	12
3/24/03	Unloaded truck with Robins parts and drove up to Barksdale to restart p/p	7
3/25/03	Arrived at site and started p/p and drove home	12
4/9/03	Drove to site t/s gas/air valve worked fine re-started p/p drove home	16
4/29/03	Drove up and t/s ATO shutdown all devices working so I restarted p/p power set to 2.5kw drove home	15
5/5/03	Drove to Shreveport to t/s ATO swings weather too bad to trouble shoot	6
5/6/03	Removed strainer from glycol line and started p/p setpoints are correct but ATO is still swinging	9
5/7/03	PP shutdown this morning but didn't call in. I re-started with help from PLUG but ATO swings persisted and methane slip is suspected. PLUG is sending a new CPO and SARC drove home	11
5/12/03	Arrived back on site and changed CPO	10
5/13/03	Started reduction but p/p kept shutting down on high or low ATO	10
5/14/03	Continued reduction but couldn't finish even by massaging p/p PLUG is sending new parts and 2 techs to figure this out	9
5/15/03	Installed new air TSI and gas/air block and SARC modem test was a success but p/p still would not stay running but I did finish reduction	11
5/16/03	Worked with the guys from PLUG and started the p/p it took a lot of effort to keep it going we shut it down and did more t/sing and determined de-sulphurization bed was used up	10
5/17/03	Installed new de-sulphurization bed and p/p started fine and ran great cell stack is weak but still at 2.5kw modem not working though drove home	13
6/16/03	Drove to site and found p/p had shutdown due to loss of grid tried to re-start but kept getting KW CONTROL FAILURE	11
6/17/03	Failure was due to a bad air TSI replaced it and started p/p drove home	14

July-03

Barksdale

Date	PP S/N	Activity	Hours
7/21/03	SU-01R	Drove to site changed cell stack and installed 1.24 software started p/p	4
7/22/03		Returned to site to check p/p everything working fine checked with Plug to verify p/p call in drove home	10
7/29/03		Lost contact with p/p drove up to investigate on site I could not establish comm with SARC	10
7/30/03		More t/sing of comm problem with no good results. Plug thinks it may be bad scanner cards but is researching to be sure, drove home pending results.	4
		Totals	28
7/21/03		drove to site changed cell stack and installed 1.24 software started p/p	12
7/22/03		returned to site to check p/p everything working fine checked with Plug to verify p/p call in drove home	8

August-03

Barksdale

Date	PP S/N	Activity	Hours
8/18/03	SU1-R1	Drove to site to resolve communications problem. New scanner cards did not fix issue	2
8/19/03		Installed new SARC resolved communications problem. Therminol pump not working; drained system and removed. Filter re-filled and tried pump again no luck. Plug sending new parts	9
8/20/03		Tried new pump and control board to no avail. Unit still down. Plug sending PDB	5
8/28/03		Drove to site installed new PDB and went for start. Had multiple problems with SARC failures to control various start functions.	5

After several attempts, finally restarted. Set 2.5 kW.
Departed site.